Description

Method and device for transmitting IP packets between a
Radio Network Controller (RNC) and a further element of a
5   mobile radio network

The invention relates to a method and a device in a
mobile communication network with which coder-decoder
mode changes are implemented centrally in the case of IP
10   packets to be exchanged between mobile radio users.

The object of the present invention is to optimize a
method and a device of the type mentioned above to the
effect that a reduction in the signaling load is achieved
15   by managing coder-decoder mode changes centrally.

According to the invention this object is achieved by the
objects of the independent Claims relating to the method
and the device. Developments of the invention are
20   specified in the subclaims. The inventive transmission of
IP packets between a Radio Network Controller (RNC) and a
further element of a mobile radio network has the
advantage that the Radio Network Controller (RNC) does
not have to know the coder-decoder mode(s) available
25   currently and in the future. There is therefore no need
for a software update at the Radio Network Controllers
(RNC). The RNC (2) has to open an IP packet (user level
IP packet) that is considered in its entirety as data.
The RNC (2) therefore does not have to know how the data
30   is structured. Nor does the RNC (2) have to know which

RTP protocol header, IP protocol header, UDP protocol
header and RTP payload header are used.

The invention is described in more detail with reference
to an exemplary embodiment shown in the Figures, in
which:

Figure 1   shows an inventive network architecture with a
device (DCF) to support a coder-decoder mode change
Figure 2   shows data relating to the exchange of coder-
decoder and mode in the event of a call
Figure 3   shows the integration of the access network
Figure 4   shows the integration of the core network
Figure 5   shows the structure of an OCS frame (OCSF)
Figure 6   shows the information from the RAB subflows
used
Figure 7   shows the processing of an IP packet in the
event of a call between two mobile terminals
Figure 8   shows the processing of an IP packet in the
event of a call between a base station and a mobile
terminal
Figure 9   shows the data packet at the individual
stations for a call between two mobile terminals
Figure 10 shows the data packet at the individual
stations for a call between a mobile terminal and a base
station.

An IP packet is converted to an optimized codec support
frame for transport between two radio network controllers
and divided into different RAB subflows for transport

between the radio network controller and the mobile
terminal.

Figure 1 shows the network architecture used for the
5   method for transmitting IP packets between Radio Network
Controllers (RNC) in the event of calls between mobile
terminals. An IP packet (e.g. AMR coded voice) goes from
a first mobile terminal (1) to the Radio Network
Controller (2), where it is encapsulated in an OCS frame
10   and is forwarded from there via the serving GPRS support
node (3) to the gateway GPRS support node (4). A mobile
terminal (1, 11) represents a mobile radio device, a
hand-held computer, a mobile computer, a combination of
said devices, etc. The RNC (2) has a table for this
15   purpose, which is created dynamically as the connection
is set up so that the TFCI value can be exchanged for the
corresponding RFCI value and the TFCI req. value for the
corresponding RFCI req. value. The RNC (2) is thereby
given the information (RANAP: RAB assignment) that
20   enables it to predefine the corresponding coder-decoder
mode based on the current situation on the air interface.
It is not necessary for the RNC (2) to know the coder-
decoder mode but it does need to know its characteristics
(e.g. required bandwidth). The OCS frame has the fields
25   RFCI, RFCI req., optional fields and the IP packet,
whereby the sequence of fields is determined in the
implementation phase. Transport is effected for example
by means of a GTP-U header, which is created by the RNC
(2). The GGSN (4) forwards the OCS frame to the coder-
30   decoder mode indication exchange system (DCF) (5) and the
latter uses a table (5a) to verify the coder-decoder mode

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indication used and where necessary exchanges this for
another. The OCS frame can thereby be transported between
the GGSN (4) and the DCF (5) in one piece (one argument)
or divided into different arguments (RFCI = argument 1,

5   RFCI req. = argument 2, IP packet = argument 3). The
coder-decoder mode indication exchange system (DCF) (5)
can be integrated in a communication network as a central
element or a non-central element. The DCF (5) can thereby
be its own node, an element of the GGSN (4) or another

10   node. In the case of a central DCF (5) the RFCI value is
converted by the sender to the RFCI value of the
recipient and the RFCI req. value of the sender to the
RFCI req. value of the recipient. It is a further task of
the DCF (5) to compare the requested coder-decoder mode

15   (represented by the AMR req. value) with the RFCI req.
value. If these are different, the DCF (5) exchanges the
AMR req. value according to the RFCI req. value.
In the case of one DCF (5) per GGSN (4) the DCF (5)
receives an RFCI value, an RFCI req. value and the IP

20   packet from the GGSN (4). The DCF (5) then compares the
AMR coder-decoder mode req. with the RFCI req. value and
exchanges the AMR req. value, if the values do not
correspond. For the recipient direction the IP packet is
forwarded by the GGSN (4) on the basis of an indicator

25   (e.g. TFT evaluation) to the DCF (5), where the AMR
coder-decoder mode and the AMR coder-decoder mode req.
are determined and replaced by the corresponding RFCI
value and RFCI req. value. The difference between a
central and a non-central DCF (5) is that in the case of

30   a non-central DCF (5) a DCF invocation takes place twice
for one call between two mobile terminals (1, 11). The

exchange can for example be assigned by the RNC (2) as a
function of load to the DCF (5) based on the RFCI req.
value. The OCS frame is sent again to the GGSN (4) and
forwarded to a recipient mobile terminal (11) via the
5   individual nodes (SGSN) (3) and RNC (2). Decapsulation
takes place again in the RNC (2). If the recipient is a
base station (15), the IP packet is forwarded to this
from the GGSN (4) or the DCF (5) itself via a firewall
(8), the internet (9) and an external network (10).
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Figure 2 shows how the coder-decoder mode(s) used for a
call are determined between two mobile terminals 1 and
11. It must be ensured here that a mobile terminal (1)
has determined a bearer for the transport of, for
15   example, SIP messages. SIP messages contain a list of all
possible coder-decoder mode(s) to be negotiated from the
point of view of the caller. The mobile terminal (1)
sends a SIP message with for example SDP information
containing the proposed coder-decoder mode(s). The SDP
20   protocol is preferred for the transport of coder-decoder
mode(s) but other protocols such as html or xml could
also be used. The called mobile terminal (11) sends
coder-decoder mode(s) with which it wishes to carry out
the call in response. The call state control function
25   (CSCF) (7) of the IP multimedia subsystem (IMS), which
can be accessed via the IP network (6), can intervene
during the determination of the coder-decoder mode(s)
used, if coder-decoder mode(s) other than those proposed
by the mobile terminals (1, 11) are to be used. The IP
30   network represents what is known as the operator-specific
IP network (3GPP 29061). Both mobile terminals are now

ready for the transmission of coder-decoder mode(s),
which can be implemented on both sides. In the case of
AMR coded voice the mobile terminal must convert the
coder-decoder mode(s) to be transmitted to for example
5   SDU parameters. If the CSCF (7) or another node involved
in the transmission of the coder-decoder mode(s) while
the call is being set up has already converted coder-
decoder mode(s) to SDU parameters, the SDU parameters
have to be forwarded to the mobile terminals (1, 11) in
10   order to improve the SDP or SIP protocol. The sequence of
SDU parameters can be identical to the transmitted coder-
decoder mode(s) in the SIP/SDP list, which contains the
negotiated coder-decoder mode(s).

15   Figure 3 shows the initialization of the access network.
Here the SGSN (3) knows the coder-decoder mode(s) to be
used for the call. This is achieved for example via SDU
parameters. The 3GPP session management protocol
procedures "Activate PDP context", "Modify PDP context"
20   or "Activate secondary PDP context" are extended for SDU
parameter transmission (with the same sequence as the
corresponding coder-decoder mode(s) of the coder-decoder
mode(s) transmission, as expressed by the coder-decoder
mode(s) at the SGSN (3). As a result the SGSN (3) does
25   not know about the type of service, which means that the
SGSN (3) does not have to be initialized with all the
different coder-decoder mode(s) that might be requested
for a call. The SGSN (3) therefore knows nothing about
the transmitted service. The RANAP (RAP allocation)
30   request, which contains the SDU parameters assigned to
the mobile terminals, is invoked by the SGSN (3) for the

transmission. The RRC protocol message, which determines the RAB subflows according to the SDU parameters, is called by the RNC (2). The header fields (Transport Format Combination Identifier) TFCIs and (RAB SubFlow

5   Combination Identifier) RFCIs in data packets are stored in the RNC (2) for the call according to the SDU parameters received. The sequence of TFCIs and RFCIs corresponds to the SDU parameters received. TFCIs and RFCIs are used to identify the coder-decoder mode(s),

10   without the RNC (2) having knowledge of the coder-decoder mode(s). The RNC (2) therefore does not have to know anything about the transmitted services. When RAB subflow setup has been completed successfully, the RRC protocol message is sent by the RAB subflows that connection setup

15   has been completed. The mobile terminals (1, 11), the RNC (2) and the DCF (5) are the entities which know how the RFCIs are mapped onto SDU parameters.

Figure 4 shows initialization of the coder-decoder
mode(s) in a core network. For calls between a base
station and a mobile terminal as well as between two
mobile terminals the DCF (5) knows which RFCIs stand for
5   which SDU parameters. The mapping between RFCIs and their
corresponding coder-decoder mode(s) and the conversion of
an IP packet to an OCS frame are thereby prepared.
Alternatively in the case of calls between two mobile
terminals the DCF (5) can exchange the values of the RFCI
10   and the requested RFCI, as the RNC (2) [lacuna] express a
type of SDU parameter, which [lacuna] a specific coder-
decoder mode with a different RFCI from the corresponding
RNC (2), which operates the corresponding recipient
mobile terminal (11). For simplification purposes, the
15   RFCIs used should have the same sequence as the SDU
parameters and the SIP/SDP associated coder-decoder
mode(s). The DCF (5) uses a table to be able to convert
the RFCIs and OCS frames to IP packets and vice-versa.
The table contains the RFCIs and corresponding SDU
20   parameters as well as the tunnel endpoint identifier for
PDP contexts for mapping the corresponding RFCIs. Further
to a positive response by means of the RRC call setup
message, the RNC (2) responds with a RANAP message and
adds the RFCIs and their significance for the call. The
25   SGSN (3) sends the RFCIs and their significance to the
GGSN (4) via a GTP-C extension header. On receipt the
GGSN (4) sends the RFCIs and their significance to the
DCF (5), where initialization takes place for the call.
The DCF (5) is now prepared to store the RFCIs and to
30   convert IP packets to OCS frames and vice-versa.

Figure 5 shows the structure of an OCS frame. The coder-
decoder mode used is [lacuna] by the RFCI value at the
OCS frame. Further table fields in the data packet can be
added optionally. However they have to be such that they
5   can be interpreted by the recipient. The IP header field
contains the information for reconfiguring the IP packet
header. Some OCS frame information could be transmitted
via a GTP extension header but this depends on
standardization or implementation in a network.
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Figure 6 shows the table information for division into
different RAB subflows.

Figure 7 shows how an IP packet is transmitted from a
15 mobile terminal (1) via individual network nodes to
another mobile terminal (11). An IP packet to be sent is
divided by the mobile terminal (1) into different RAB
subflows (12). The values for TFCI, TFCI req. and any
further values are thereby filled in with values
20 originating from the IP packet. The RAB subflows (12)
transport the IP packet to the RNC (2). Header
compression like the IP/UDP/RTP header via the air
interface is optional. In the RNC (2) the value for TFCI
is exchanged for the corresponding value for RFCI and the
25 value for TFCI req. is exchanged for the corresponding
value for RFCI req. The RNC (2) has an appropriate table
or array for this. As a result the IP packets divided
into RAB subflows (12) are converted to OCS frames. The
GTP-U header is then created by the RNC and prefixed to
30 the OCS frame (13) and forwarded via the Serving GPRS
Support Node (SGSN) (3) to the Gateway GPRS Support Node

(GGSN) (4). The GGSN (4) forwards the frame to the coder-decoder mode indication exchange system (DCF) (5). In the case of a central DCF (5) said DCF exchanges the RFCI and RFCI req. values between the two mobile terminals (1,

5   11). The DCF (5) also compares the AMR req. value in the IP packet with the RFCI req. value and exchanges it where necessary. Where there is one DCF (5) per GGSN (4) the DCF (5) removes the RFCI and RFCI req. value and .overwrites the AMR req. value with the RFCI req. value.

10   [lacuna] gives the IP packet back to the GGSN (4) and the latter adds the GTP-U header (plus the GTP-U extension header) and sends the packet in the direction of the recipient RNC (2) in the case of a call between two mobile terminals (1, 11). The IP packet is sent

15   beforehand via the recipient GGSN (4) to the recipient DCF (5) and the RFCI and RFCI req. values negotiated for the mobile radio terminal (11) are set and sent again to the GGSN (4). If the recipient is a base station (15) the IP packet is forwarded immediately from the GGSN (4).

20   The GGSN (4) may exchange or modify the GTP-U header and send the OCS frame (13) to the SGSN (3), which forwards it to the RNC (2). The RNC (2) replaces the RFCI value with the corresponding TFCI value and the RFCI req. value with the corresponding TFCI req. value and divides the IP

25   packet into a plurality of RAB subflows (14), which forward the IP packet via the air interface to the mobile terminal (11).

Figure 8 shows the conversion and sending of an IP packet

30   in the case of calls between a mobile terminal (1) and a base station (15). In the case of calls from a mobile

terminal (1) to a base station (15) the DCF (5) converts
an IP packet to an OCS frame and vice-versa. An IP
packet, which is sent on the uplink (from the mobile
terminal to the RNC), is divided by the mobile terminal

5   (1) into RAB subflows (12) and forwarded to the RNC (2).
The values for TFCI, TFCI req. and optional values
thereby originate from the IP packet (AMR and AMR req.
value). The IP data packet header and the encrypted data
are also taken from the IP packet. Header compression

10   e.g. the IP/UDP/RTP header via the air interface is
optional. The RNC (2) exchanges the TFCI value for the
corresponding RFCI value and the TFCI req. value for the
corresponding RFCI req. value. The RAB subflows (12) are
thereby converted to an OCS frame. The GTP-U header is

15   then prefixed to the OCS frame by the RNC (2) and
forwarded via the SGSN (3) to the GGSN (4). The GGSN (4)
decapsulates the OCS frame (13) and identifies, for
example by a tunnel endpoint identifier of the GTP-U
header, that the OCS frame should be sent to the base

20   station (15) with GTP-U (13), which must be converted
beforehand to an IP packet. For the conversion the GGSN
(4) forwards the OCS frame (13) without the GTP-U header
to the DCF (5). The DCF (5) converts the frame and sends
it back to the GGSN (4). The IP packet is finally

25   forwarded in the direction of the base station (15) by
the GGSN (4). Alternatively the IP packet could be
forwarded directly by the DCF (5) in the direction of the
base station (15) without having to be sent back to the
GGSN (4).

30   If the GGSN (4) receives an IP packet back from the base
station (15), it is identified with a specific PDP

context, according for example to the IP address or the
TFT filter, if more than one PDP context is activated for
the mobile terminal (1). The GGSN (4) knows from the
identification that it has to forward the IP packet to

5   the DCF (5), so that it can be converted there to an OCS
frame. The IP packet is forwarded to the DCF (5) for
conversion to an OCS frame together with an identifier,
which interrogates the corresponding RFCIs and RFIC req.,
and is then sent back again to the GGSN (4). Next the

10 GTP-U header is prefixed to the OCS frame and sent to the
SGSN (3), which forwards said frame (13) to the RNC (2).
After the GTP-U header has been removed, the RNC (2)
exchanges the RFCI value for the corresponding TFCI value
and the RFCI req. value for the corresponding TFCI req.

15 value, divides the IP packet into RAB subflows (12) and
sends it to the mobile terminal (1) which compiles it
again.

Embodiment of a coder-decoder mode change request at the

20 mobile terminal

The request to digitize data with another coder-decoder
mode is received in-band from the mobile radio network by
an application in a mobile terminal, a computer, etc. A

25 coder-decoder mode change is prompted by the RNC (2).
This can be effected uplink by the mobile terminal (1,
11), which requests a specific coder-decoder mode by
means of the TFCI req. value and is monitored by the RNC
and downlink the recipient mobile terminal (1, 11) is

30 requested via the RFCI req. value to use another coder-
decoder mode. This value is monitored by the RNC (2) and

if necessary corrected before it exchanges it for the
TFCI req. value. It can also be prompted by the mobile
terminal (e.g. with an RTP payload header field AMR
req.), under the supervision of the RNC (2). On account

5   of the air interface quality reports, which are sent by a
mobile terminal (11) receiving coded data to the
operating RNC (2), or by means of a trigger, e.g. the
time, the RNC (2) can request a coder-decoder mode change
from the sending mobile terminal (1), which is achieved

10   by modifying the RFCI req. value of the OCS frame, which
is sent to the sending mobile terminal. The RNC (2) can
influence the request for a coder-decoder mode change via
the SGSN (3) according to the current situation (e.g.
bandwidth in current use and time). The mobile terminal

15   receives a coder-decoder mode change request via the TFCI
req. value. The application in the mobile terminal
receives the same coder-decoder mode change request via a
field value from the IP packet, such as the RTP payload
header field AMR req. IF 1. The IP packet is then

20   forwarded digitized with the requested coder-decoder mode
to the lower layer (e.g. PDCP layer). The lower layer can
interpret the field of the IP packet containing
information about the coder-decoder mode. As a result it
verifies the IP packets received according to the coder-

25   decoder mode that correlates with the TFCI req. value and
either allows the IP packet to pass or rejects it. The
mobile terminal codes data with the coder-decoder mode
requested by the RNC (2). On the other hand the quality
of the call deteriorates dramatically due to lost

30   packets.

Embodiment of a coder-decoder change request at the DCF

The DCF receives the coder-decoder change request in the
form of an RFCI req. value. The application receives the
same request in the form of a corresponding field in the
IP packet. The application on a base station continues to
code data with the requested coder-decoder mode received
from the corresponding field in the IP packet. The IP
packet is then sent to the DCF (5) with the requested
coder-decoder mode via the GGSN (4).

As a result the DCF (5) verifies the coder-decoder mode
in this received IP packet to determine whether it
correlates with the RFCI req. value and either allows the
IP packet to pass or rejects it. Transmission of the IP
packet via the air interface can take place transcoded or
not transcoded.

Figure 9 shows the appearance of the data packet at the
individual stations in the event of a call between two
mobile terminals. The sequence of the fields is
determined on the basis of implementation and
standardization. The information (RFCI/TFCI value and AMR
value, RFCI req./TFCI req. value and AMR req. value)
about the coder-decoder mode is sent in duplicate in the
present example. To eliminate this, the RTP payload
header (contains AMR value and AMR req. value) is
modified between the mobile terminal (1, 11) and the DCF,
which means that an IETF protocol is changed.

Figure 10 shows the appearance of the data packet at the
individual stations in the event of a call between a
mobile terminal and a base station. The sequence of
fields is determined on the basis of implementation and
5   standardization.